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ABSTRACT

This paper examines the research literature that points to the function of aesthetics outside the domain of the arts and discusses its importance to creativity and creativity education. The featured literature focuses on problem finding, problem solving, verification, and the development of an aesthetic sense. (EH)

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Creativity And Aesthetic Sense

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CREATIVITY AND AESTHETIC SENSE

The ability to appreciate and respond to beauty is commonly referred to as aesthetic sense. Highly creative people share an aesthetic ability that allows them to recognize "promising" problems in their field (Perkins, 1988; Poincare, 1908, Sternberg, 1988; Walberg, 1988), to persist until a "right" solution is found. Mathematicians are reported to be able to intuitively sense the correctness of a solution by the beauty and elegance it embodies (Poincare, 1908). "Psychologists studying creative thought have also noted that the creative individual seeks beauty as well as truth, demanding that solutions be elegant." (Kay, 1996, p.1). This aesthetic sensibility, which is important to the quality of creative thought and product, is receiving increasing recognition (Kay, 1996), but remains under-studied. Scholarship in the area of aesthetics and creativity" has generated articles that mostly focus on the arts (Tardif & Sternberg, 1988). The objective of this paper is to find evidence in the literature that points to the function of aesthetics outside the domain of arts, and to discuss its importance to creativity and creativity education.

Beauty need not simply refer to something that pleases the eye. Rather, beauty is derived from the reflection of truth and order in phenomenal reality (Kant, 1790), as in nature or in nonartistic cultural phenomena such as morality, science, or mathematics (Academic American Encyclopedia, 1994). In other words, outside of art, beauty is beheld in radiant truth (Jaspers, 1957), reflected in Keats' (1819) poetic line "Beauty is truth, truth beauty". When Plato and Kant talked about aesthetic experience, the ideal they had in mind was gaining insight into the fundamental truth of nature. Aesthetic sense is therefore concerned with both perfect understanding and appreciation of the truth. To Kant, taste is individual, but beauty is universal (Kant, 1790).

I. Aesthetic sense in problem finding

Of all the problems that exist in the world, how do creative people decide which ones to address? Does aesthetic sense have a role in this decision? Clearly it influences an artist's choice of subject-matter, yet biographical studies provide some examples suggesting that creative scientists often use their intuition and aesthetic sense to identify research problems rich in potential discovery.

Like most of his contemporaries, Darwin believed in a notion of a stable, harmonious, natural order, in which all organic beings were adapted to each other as well as to their physical environment. Even in 1836 when his five-

year Beagle voyage reached its final stage, he tried to explain the unusual fauna he found in Australia by theorizing that there had been distinct and remote periods of creation as God rested in his labor (Gruber, 1981). The Biblical version lost its explanatory power for Darwin when accumulated evidence showed that the earth experienced gradual geological change over millions of years. If the physical environment changed, how did the organic species in the environment remain as God created them and still be well adapted to their surroundings? This paradox created in Darwin a sense of tension which compelled him to search for the truth until order and harmony were restored in his thinking.

A sensitivity to tension, to a lack of harmony, is essentially an aesthetic response, reflective of a person's ideal notion of beauty and truth. While Darwin could not rest until he solved the contradiction between theory and reality, most biologists and geologists at his time made peace with the Biblical theories of creation. One could argue whether they lacked Darwin's sensitivity or courage, but certainly Darwin's sensitivity to tension helped him to identify a significant problem.

According to Maxwell's theory of electrodynamics (Perkins, 1981), different equations are used to measure electric current depending on whether a magnet or a conductor is moving. Both equations provide "right" answers. Einstein speculated that since the electric current is generated by the same magnet and the same conductor, there ought not to be any real difference in its calculation (Perkins, 1981). The "thought that one is dealing here with two fundamentally different cases" "was unbearable" (Einstein's essay from Rothenberg, 1990). This strong statement of emotion bespeaks an aesthetic sensitivity that cannot tolerate the existence of such an anomaly. Such "emotional and unconscious correlates help to dictate a scientist's interest in a problem and even the particular way he initially defines and structures such a problem" (Rothenberg, 1990). This uneasiness about a lack of fit, an unbearable tension resulting from the absence of order and harmony is an aesthetic sensitivity. This sensitivity leads Einstein as well as Darwin to the discovery of an important problem in the domain.

II. Aesthetic sense in problem solving

Murray and Kluckhohn (1953) regarded the reduction of tension as a source of pleasure and satisfaction. The more tension is reduced, the greater is the pleasure. Generally speaking, the more restraints a problem has, the more criteria a solution must satisfy, the more challenging the task becomes. Darwin had a difficult problem because he had

to find a theory that could account for every biological species in every geographical location. Highly creative people are attracted to difficult problems, as these problems promise greater tension reduction (Ochse, 1990), and, by the same token, when good solutions are found, they yield more aesthetic pleasure.

The quality of a solution depends on the quality of the problem addressed (Getzels, 1975). Beautiful solutions not only meet a set of "hard" criteria of being able to account for natural phenomena and/or capable of empirical replication, but an aesthetic criterion as well: simplicity and elegance. In mathematics, the best solution to a problem is always the one that is simple and elegant. In science, the best theory can explain a great deal of data with little or no need to adjust for exceptions or outliers. Theories eventually proven false (e.g. Ptolemy's) have to address myriad specifications and rules in an attempt to explain or justify itself. Proposed theories (e.g. Newton's) eventually encounter anomalies under changed conditions. Theories that explain universals in an unconvoluted framework are most likely to remain immutable. Darwin was able to use no more than three words — generation, selection, and preservation (Perkins, 1988), to summarize the entire history of natural evolution. Einstein wrapped up the nuclear potential in a concise mathematical equation $E = mc^2$. Their theories reflect the elegance of the laws of nature.

Even in the less grand world of puzzle solving, the rule of simplicity and elegance applies. Take, for example, the 9 dot puzzle (See figure 1). Many solutions are exceptionally clever, breaking boundaries in most unexpected ways. Some require folding, wadding, rolling, cutting and rearranging (Adams, 1986); others either require big dots to allow for connection by slant lines (Solution 2), or small dots to be covered with one fat line (Solution 3). Being conditional (dot size) or multidimensional (more than one plane), they are less simple and elegant compared with Solution one. Here, I contend, the judgement involved is not right or wrong, but aesthetically more satisfying to a viewer.

In the realm of language, a simple and elegant analogy is immediately accessible to the general public (simplicity), and transcends conventional thinking (elegance). The more removed is the association, the higher the creativity. "A creative analogy is one in which the between-subspace distance is large, but the corresponding within-subspace distances are small" (Sternberg, 1988, p. 135). In other words, the analogy should be remote enough to be unique, yet near enough to be recognizable (Cramond, personal communication, 1996). For a creative analogy to go far enough without running into the risk of losing its point, one must be able to strike a subtle balance between

connection and disconnection. This tension challenges one's aesthetic as well as logical judgement.

III. Aesthetic sense in verification

For a creative work to be favorably received during one's lifetime, society must recognize it as valuable. Social agreement constitutes one aspect of creativity (Csikszentmihalyi, 1988). Kuhn pointed out, the man "who embraces a new paradigm at an early stage must often do so in defiance of the evidence provided by problem solving" (Kuhn, 1962, p. 155). The erratic nature of public judgement has claimed many victims in arts and in science (Koestler, 1964). Van Gogh and Copernicus serve as classic examples. Both were posthumously given their due, reflecting what might be interpreted as an objective side of creativity and beauty as measured by such proposed criteria as aptness, usefulness, and problem solving ability (Kuhn, 1962), or originality, emphasis, and economy (Koestler, 1964). Yet where does the recognition of a new art or scientific theory with potential for development come from? When a new-born theory has yet to demonstrate its potential, it is aesthetic considerations that keep its early believers convinced that they are on the right track. Why is it that these early believers possess a more highly developed aesthetic sense than others?

According to the systems view of creativity, individual innovations in a domain are not selected to be preserved as creative until they are recognized by the field as such (Csikzentmihalyi, 1988). This view of creativity acknowledges the importance of expertise in the form of sophisticated judges, gatekeepers, and other purveyors of taste. Compared with laymen, professionals have developed a more discriminating perception and a more refined, if not opinionated, aesthetic taste. Their training, knowledge, and experiences enable them to know the criteria for evaluating an intellectual product (Parsons, 1978). On the other hand, expertise does not guarantee an infallible aesthetic sensitivity. Many prominent people resist a new theory when it is first introduced. Clearly, Darwin was one of the few among his fellow scientists who sensed the limitations of biblical creation to explain natural selection.

Since Plato, many scholars have drawn the distinction between learning and knowing (Conklin, 1971). Learning is the accumulation of facts, data, opinions, or propositions, while knowing requires a creative integration that goes beyond the given data. Knowing is profound understanding, deep appreciation, and personal commitment to truth, wisdom, and beauty. Hence it is "essentially an aesthetic activity" (Conklin, 1971, p. 540). Applying this distinction, we may classify those who can appreciate the beauty and truth of a new theory before its power and

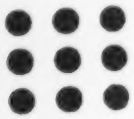
validity are fully demonstrated as the "knowing type," while those who place their trust exclusively in hard evidence are the "learning type." The difference between the two is not so much in the amount of knowledge as in the feel for it. MacKinnon's (1963) three groups of architects further illustrates this point. Architects I (the most creative) "see some inner artistic standard of excellence and a sensitive appreciation of the fittingness of architectural solutions to that standard." (p. 184). Architects II (the less creative) "place more stress on the efficient execution of architecture," (p. 184), and value strong powers of spatial visualization as the most salient characteristic of the ideal architect. Architects III (the least creative) place a greater value on the standards of the profession than on their own internal judgments, who show a "strong sense of responsibility to the group, rather than to themselves or to some inner ideal of perfection which is uniquely theirs" (p. 184). For the creative architects, professional standards have been so thoroughly internalized as to become second nature, allowing their work to reflect spontaneous and intuitive self-expression. With the less or least creative, however, the standard of the profession, though learned, is yet to be assimilated, to serve not only the mind, but also the heart till they can find their true vision. As the knowing type can rely on his or her whole being --- feeling, intuition, faith, in addition to rational thinking when they respond to creative work, they become especially sensitive to beauty and truth in its various expressions.

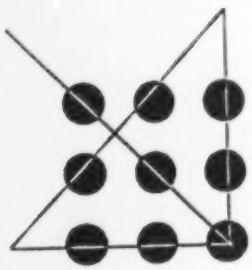
IV. The development of aesthetic sense

One objective of creativity development in schools should be to strive to refine students' aesthetic sense. Generating floods of papers, patents, and works of art (Jarvie, 1981) detracts from the purpose of creativity education per se. A possible way of achieving quality problem finding and solving that includes aesthetic decision-making is to observe mentors modeling the process. Subotnik and Steiner (1994) in their longitudinal study of 1983 winners of Westinghouse Science Talent Search found that those subjects who formulated their own research questions were socialized into this process by a mentor. Interviews with masters in the arts and sciences also reveal that the scientific judgement or "taste" needed to identify promising research questions is generally learned by apprenticeship to an expert researcher (Subotnik, 1995). Disciplined practice is another way to acquire a good aesthetic sense in the domains where professional judgement functions as its essential component. Research on the path from novice to expert has shed light on the development of an ability to "home in" on the right problem and a good solution. Experts' sophisticated discrimination between a real solution or only a flashy but insufficient answer (Parsons, 1978)

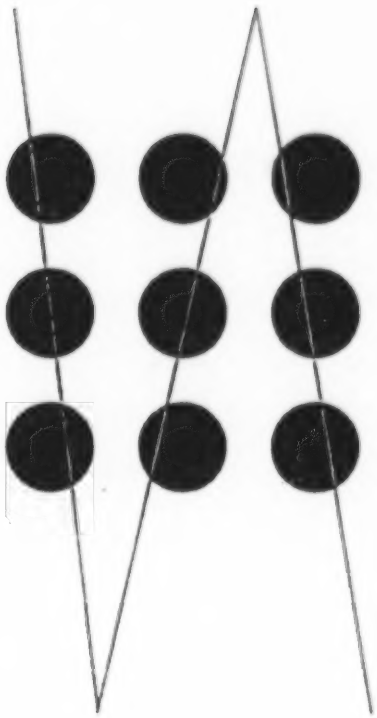
comes from their structured domain knowledge and their facilitated access to it through years of painstaking practice (Frensch & Sternberg, 1989). Radiologists have to read tens of thousands of X-rays before becoming expert in radiological diagnosis (Pressley, 1995). Studies compiled by Bloom on talent development found that the stage wherein talented people developed their own style and voice came after years of faithful imitation and disciplined practice (Bloom, 1985). Piirto (1992) reports that aesthetic appreciation of music comes in the middle years of talent development. Though aesthetic sense is shaped by the different domains, an insightful perception, sound judgement, subtle discrimination, and intelligent evaluation underlie it all. When we denounce the mechanical drill and kill in the traditional classroom, we should, at the same time, search for possible alternatives that enable students to develop understanding and intuition through meaningful practice, to help them not only to learn, but also to know. In the name of creativity, we have been trying to inculcate in our students the idea that there are no right or wrong answers to certain questions. Maybe we should at the same time help them judge good, better, and best answers. It is the quality of ideas that makes creative products valuable.

Puzzle: Draw no more than four straight lines (without lifting the pencil from the paper) which will cross through all nine dots.





Solution One



Solution Two

Solution Three

Figure 1 (Adapted from Adams, 1986)

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